

ELECTRONIC FUNDAMENTALS

Service Practices 9:

HOW TO REMOVE CHASSIS
AND LOCATE SIMPLE DEFECTS

Service Practices 10:

HOW TO TEST TUBES



RCA INSTITUTES, INC.

A SERVICE OF RADIO CORPORATION OF AMERICA

New York,

N. Y.

ELECTRONIC FUNDAMENTALS

SERVICE PRACTICES 9

HOW TO REMOVE CHASSIS AND LOCATE SIMPLE DEFECTS

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Service Practices 9

INTRODUCTION

In order to repair almost any radio or television receiver, it is necessary to remove it from its cabinet. Almost anyone can figure out how to get a chassis out of a cabinet in one way or another, but unless you know how to do it quickly and correctly, it may take you longer to remove the chassis than to do the actual repair work. Also, unless you know what precautions to take, you may damage one or more parts of the chassis or even the cabinet itself. You will have to repair this damage at your own expense; therefore, you will lose time and money on the job. Besides that, your reputation as a radio or television serviceman will naturally suffer.

This booklet tells you how to go about removing a radio or radio-phono chassis from its cabinet. It tells you what to do, how to do it, and what special tools you may need to use. It also tells you what not to do and what to look out for, so that you won't accidentally damage the customer's property. In addition to this, it tells you about certain checks that you can make that will save you time and work. After you have had some experience, you will be able to figure out the correct way to remove even a chassis that is fastened in its cabinet in an unusual way. Because the removal of a television chassis from its cabinet requires special instructions and special precautions, it is discussed later in the course.

There is one thing that this booklet cannot do; it cannot supply you with all of the necessary knowledge of service and test methods that will prepare you to troubleshoot and overhaul a radio or phono-radio combination. However, step by step, booklet by booklet, these Service Practices booklets

will give you this information. For example, the next booklet tells you how to test tubes. Later booklets tell you how to repair dial cords and tuning systems, how to test resistors, inductors, and capacitors, and many other things that you must know before you take on the job of troubleshooting and repairing radio and phono equipment all by yourself. You'll find that each Service Practices booklet is sent to you at a time when your study of electrical, radio, and television theory has prepared you to understand it better.

So, while this Service Practices booklet tells you how to remove a chassis and make some very simple tests, it does not give you the "green light" to go ahead and try to make repairs on the chassis. You will not be prepared to do such things until you have more knowledge and experience.

However, while you may not be prepared to service radio equipment all by yourself, it is possible for you to use the information you already have and to gain experience by helping some friend who does radio service work or by doing some part-time work in a local radio-television service shop. There are many things that you can do to help in a service shop, even though you are not prepared to do the testing and troubleshooting. And, of course, as you read each Service Practices booklet, you will add new ways to apply your knowledge and increase your usefulness in the shop.

9-1. FIRST STEPS

Before you take a chassis out of its cabinet, make sure that it is really necessary to do so. Of course, if you know that the chassis must be removed or if you are help-

ing out in a service shop and are told to remove the chassis, then there is no question about it — the chassis must come out. However, if you are in a customer's home, or if the customer has brought a radio or phonoradio combination to the shop for service, you can find out if it is necessary to take the chassis from its cabinet by making some simple checks. First, turn on the receiver yourself to check the customer's complaint. In many cases, you will find that the trouble shows up right away. Sometimes, the receiver may operate properly and not seem to have anything wrong with it. In such a case, ask the customer to operate the receiver and show you the trouble. You may find that the customer does not know how to tune the receiver properly and needs to be shown how to do it correctly. Or, if the trouble does not appear when you first turn the receiver on, the trouble may be an *intermittent* one, that is, one that comes and goes. Troubles of this type may show up after the receiver has been operating for some time. If you are in the customer's home, you will have to take the receiver to your shop and let it operate on your workbench until the trouble shows up. The customer may tell you that striking the receiver causes the trouble to appear, or that when the trouble appears, jarring the receiver restores it to normal operation. Let him show you this, but do not strike the receiver or chassis yourself in the customer's presence. (Later Service Practices booklets will tell you how to test a receiver in this condition.)

If the operation of the set shows there is something wrong, make the following checks before starting to remove the chassis.

Tubes. Check the tubes. If the trouble is due to one or more defective tubes, it may be possible to correct the trouble without removing the chassis from the cabinet. Complete information on testing tubes is given in your next Service Practices booklet. However, before testing tubes, make sure that no tube is missing and that each tube is firmly seated in its socket. A missing tube will naturally cause trouble, and a loose tube may do the same.

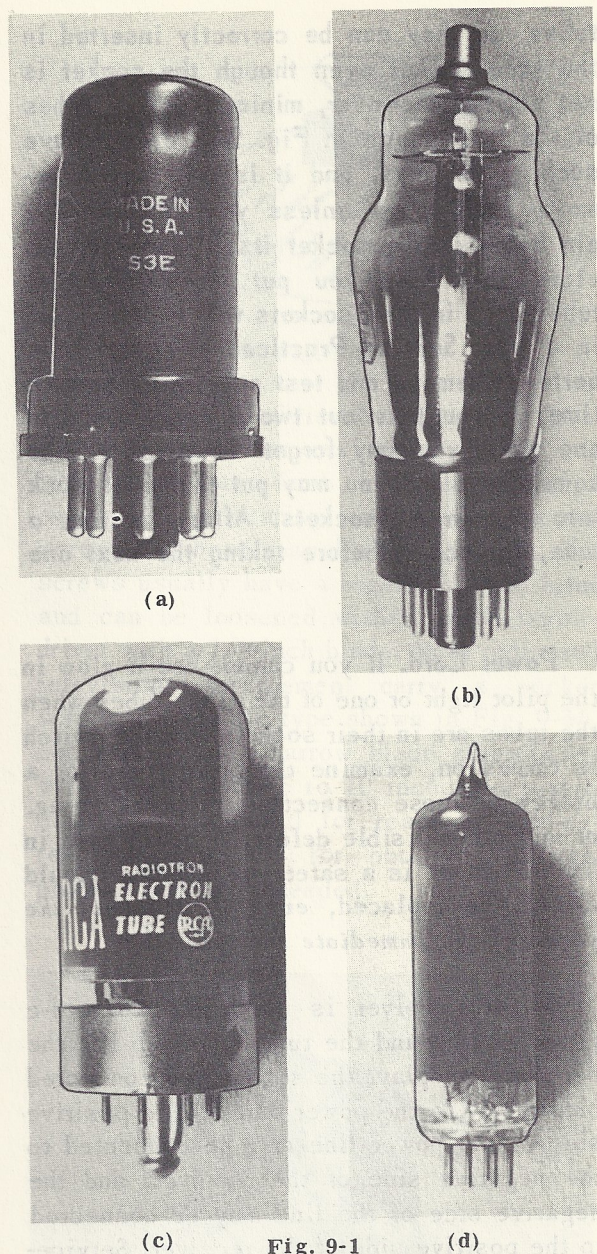


Fig. 9-1

Caution: Before testing tubes, examine the position of each tube to see whether it can be easily removed, tested, and returned to its socket without first removing the chassis from the cabinet. Although it is easy to pull a tube out of its socket, if you can get hold of it and there is room for the tube to clear the cabinet, it is not always easy to get the tube back into its socket again. Also, it is necessary to be able to see the socket in order to replace some tubes. Standard-size metal, glass, and lock-in type tubes, as shown in Fig. 9-1a, b, and c, have keys and guides for inserting the

tubes so they can be correctly inserted in the tube socket even though the socket is not visible. However, miniature glass tubes of the type shown in Fig. 9-1d do not have such guide keys, and it is best not to remove such tubes unless you can see the pin holes in the socket itself. (Special devices that help you put these miniature tubes back in their sockets will be described in a later Service Practices booklet.) It is better to remove and test only one tube at a time; if you take out two or more tubes at one time, you may forget where each tube comes from and you may put the tubes back into the wrong sockets. After you test a tube, replace it before taking the next one out.

Power Cord. If you cannot see a glow in the pilot light or one of the glass tubes when the tubes are in their sockets and the switch is turned on, examine the power cord for a broken or loose connection, a broken plug, or any other visible defect. A power cord in bad condition is a safety hazard and should always be replaced, *even if it is not the cause of the immediate trouble.*

If the receiver is connected to a d-c power source and the tubes light up but the set does not play, the set may be connected incorrectly to the power outlet. The positive side of the power line may be connected to the negative side of the receiver, and the negative side of the line may be connected to the positive side of the receiver. Servicemen call this *reversed polarity*. To check for reversed polarity, remove the attachment plug from the power outlet, turn it half-way around, and plug it in again. Then, if the trouble was reversed polarity, the set will operate.

Antenna. Examine the connections to the loop antenna. If the rear of the cabinet is open, this connection can be easily seen. If the cabinet has a back, it must be removed in order to examine the antenna. Make sure that the antenna connections are good and that none of the leads short against each other or against the chassis. If you are in

the customer's home and an outdoor antenna is used, examine the connections both at the receiver and at the point where the antenna enters the house.

Switches. Examine all switches on the receiver and phono-radio combination. If a switch is used to change the receiver tuning from the broadcast band to the FM band or to one or more short-wave bands, turn it to the broadcast-band position. Then tune the receiver to see if it operates at any part of the dial. Sometimes there are no local broadcasts on the FM band, or the short-wave bands may be unusually quiet, so that the receiver may seem to be *inoperative* (a term that servicemen use often and which means *does not operate or does not work*). Examine the position of the radio-phono switch, if one is used. Such a switch is used to change over the receiver from radio to phonograph operation; the receiver will appear completely inoperative if this switch is in the phono position. If you are examining a radio receiver in the customer's house, you may find that there is a special line that runs from the receiver to a phono player in some other part of the room. This line may include a switch or jack that is used to silence the radio when the phonograph is operated. So, if you find cable or wires leading away from the receiver that you cannot account for, ask the set owner to tell you what they are connected to, if they are controlled by switches, and if the switch is in the radio position.

9-2. SAFETY PRECAUTIONS

When working in the customer's home, always keep in mind the following safety precautions:

1. Clear a working area around the radio receiver so that you will have room in which to work and so that there will be no danger of your knocking over lamps, vases, or other easily-broken articles that are normally nearby. It may even be necessary to move one or more pieces of furniture to one side to give you working room. However, before

moving anything, ask for the customer's permission. In many cases, you will find that the customer will prefer to move a delicate vase or lamp herself, rather than permit you to handle it. In fact, it is much better to let the customer handle any easily-broken articles, so that you do not take the chance of accidentally breaking something while moving it. If any furniture must be moved to give you room, do not attempt to move it by yourself unless it is of a reasonable size and weight. You should not move furniture that is unusually large or heavy without some assistance.

2. Never place your tools on top of the receiver or phono cabinet, on any other piece of furniture, or even on the floor. Spread a drop cloth, such as the one shown in Fig. 9-2, for your tool box or tools. This will prevent the scratching of either the furniture or the floor and make it easy for you to collect all your tools when you have finished your work.

3. If it is necessary for you to use either an extension lamp for a working light or a soldering iron, make sure that the wires are not placed where someone may trip over them. Have a good holder for your soldering iron so that it will not fall off and cause burns.

4. Make sure that the power cord is disconnected before you begin removing the chassis from the cabinet.

9.3. REMOVING THE CHASSIS FROM THE CABINET

Removing the Knobs. The first step in removing the chassis is to remove the knobs from the control shafts that come through the holes in the cabinet. This is sometimes much easier said than done. For this reason we must consider how these knobs are fastened to the shafts and why they might be difficult to remove.

A knob is held on its shaft either by a set screw or by a spring pressure. A set

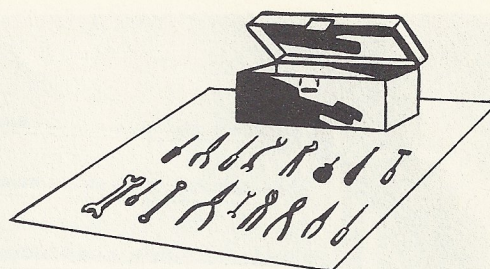
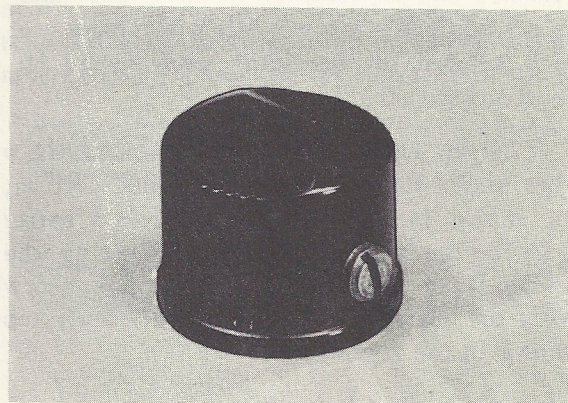
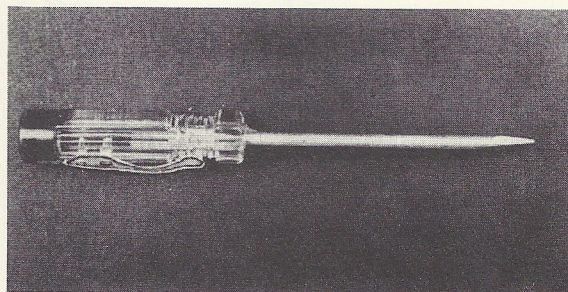


Fig. 9-2

screw type of knob is shown in Fig. 9-3a. One or two set screws may be used. See whether or not a knob is fastened with a set screw by rotating it. If there is a set screw, its head may be easily seen. Set screws usually have a regular slotted head and can be loosened with a small screwdriver with a 1/8-inch blade. Most radio and television servicemen carry a pocket screwdriver of the type shown in Fig. 9-3b, but sometimes a narrow blade screwdriver with a shaft from 6 to 10 inches in length can be very useful for reaching hard-to-reach places and for obtaining enough power where it is needed.



(a)



(b)

Fig. 9-3

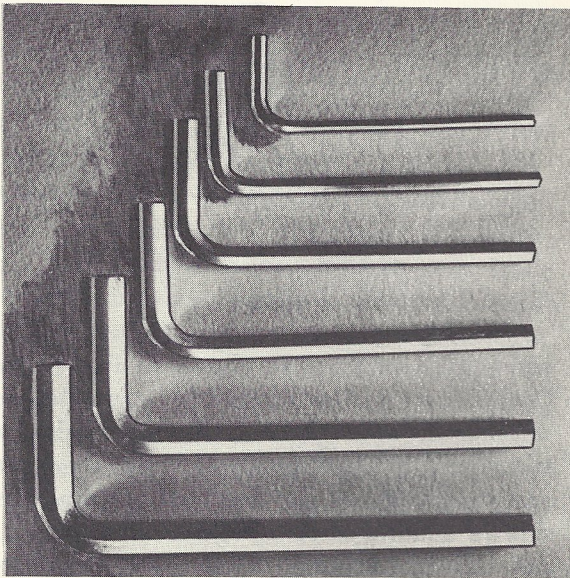


Fig. 9-4

Some knobs are fastened with Allen-type set screws. This type of screw has a six-sided socket instead of a straight slot and is fastened and unfastened by an Allen or hex-wrench. Figure 9-4 shows several Allen set screws and wrenches. Kits containing five or six wrenches of the most useful sizes for radio and television servicemen can be obtained in most radio and television parts stores. Allen wrenches are also needed for servicing many types of record changers.

Control shafts designed for set screw type knobs usually have a flattened portion, as shown in Fig. 9-5, to provide a better grip for the set screw. When replacing the knobs, take care to line up the set screw with the flattened portion of the shaft, as shown in the figure.

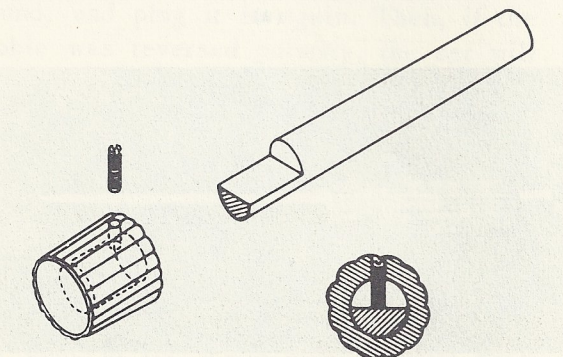


Fig. 9-5

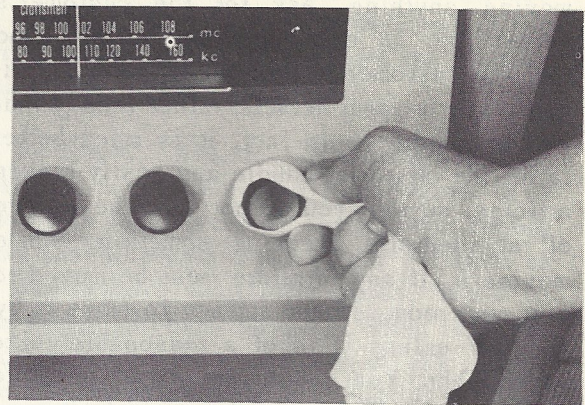


Fig. 9-6

Sometimes, due to swelling or corrosion, the knob will not come off the shaft after the set screw has been loosened. A better grip can be obtained on such stubborn knobs by wrapping a piece of strong cord, cotton tape, or even a handkerchief underneath and around the knob as shown in Fig. 9-6. You will then be able to pull harder on the knob.

However, be sure to pull straight back, without any sidewise pressure, or you may bend the shafts. Commercial knob pullers, such as the one shown in Fig. 9-7, are available, but you may scratch cabinets when you use them. A useful protective shield can be used with a knob puller. It can be made from a piece of thin cardboard about two or three inches square, which can be slipped over the shaft behind the knob, as shown in Fig. 9-8, and will protect the cabinet while the knob puller is in use.

In certain instances, it will not be possible to remove the knob. There may be so

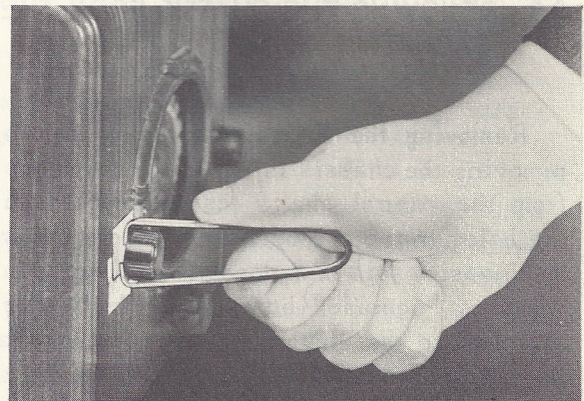


Fig. 9-7

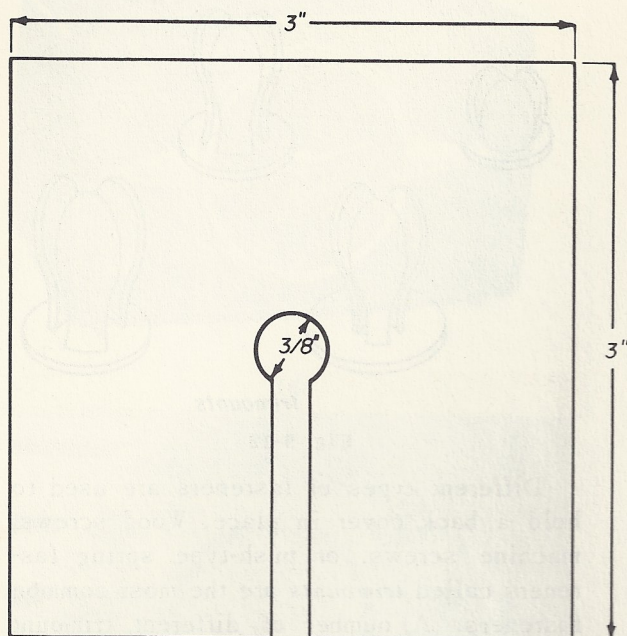


Fig. 9-8

much swelling or corrosion that it cannot be pulled off. The slot in the set screw may be broken or worn so that the set screw cannot be loosened. The only thing you can do then is to break the knob in order to remove the chassis. When it is necessary to break the knob, and if you are working in the customer's home, explain the need for breaking the knob to the customer before you attempt to break it. In this way, she will not become alarmed and think that you are willfully destroying her property. When breaking a knob, be careful that you do not cause any damage to either the cabinet or the chassis. A good method of breaking knobs is to squeeze the knob with gas or adjustable pliers, after first protecting the cabinet with a cardboard shield like the one

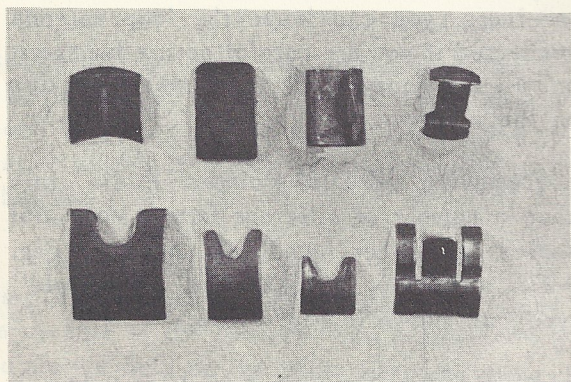
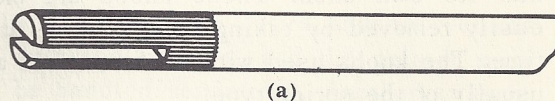


Fig. 9-9

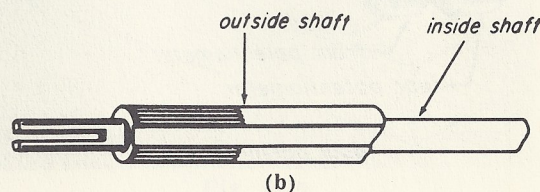
described above. Apply pressure with the pliers slowly until the knob breaks. The replacement knob should match the remaining knobs of the receiver. If you cannot find a matching knob, the entire set of knobs should be replaced. If it is necessary to order a set of knobs, give the customer a knob that doesn't match until the new knobs arrive. Explain this to the customer.

If no set screw is visible, the knob is held on the shaft by some type of spring pressure. The springs may be inserted inside the knob so as to cause a tight fit between the knob and the shaft. Some springs of this type are shown in Fig. 9-9.

Another method of holding knobs tightly is the split shaft, shown in Fig. 9-10a. The part over which the knob fits is usually *knurled*, or grooved, as shown. When the knob is pushed on the knurled part of this shaft, it squeezes the split sections together lightly, creating a spring pressure. A knob held on by spring pressure can be removed by pulling it straight back off the shaft. Usually, these knobs can be easily removed with the fingers. If not, they can be removed with a knob puller. When you remove



(a)



(b)

Fig. 9-10

a spring-type knob, a spring like those in Fig. 9-9, the springs may fall out. Be on the look out for this so that you do not lose them.

When replacing the spring, be careful not to put it in backwards, as this will make it very hard to remove the knob. You can find out the correct way to replace the spring by checking one of the other knobs. The top two shafts shown in Fig. 9-10*b* are used on single controls. The remaining shaft, sometimes found on dual controls, uses a split shaft for one control and a knurled shaft for the other.

Pushbutton knobs are usually of the spring type. Other pushbuttons are held by force fit, or friction, between the inside of the knob and the pushrod. The chassis may sometimes be removed without removing the push-button knobs.

Sometimes dual or concentric controls are used. Such a dual control is shown in Fig. 9-11. One of the two controls has a hollow shaft. The two controls are placed one behind the other, with the shaft of one control going through the hollow shaft of the other. Such controls reduce the apparent number of knobs on the front panel, thus improving the cabinet's appearance. Each shaft has its own knob. These knobs are most easily removed by taking them off one at a time. The knobs used with such controls are usually of the spring type.

Removing the Back Cover. If the receiver has a back cover, the next step in removing the chassis is to remove the back cover from the cabinet.

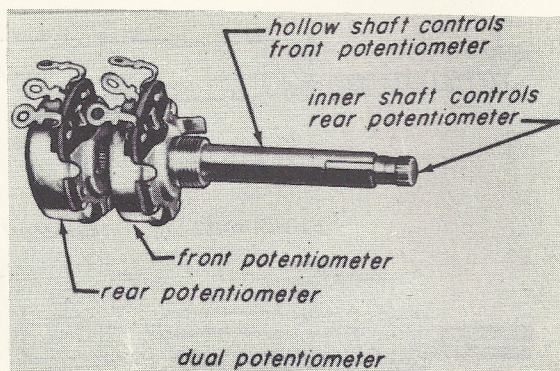
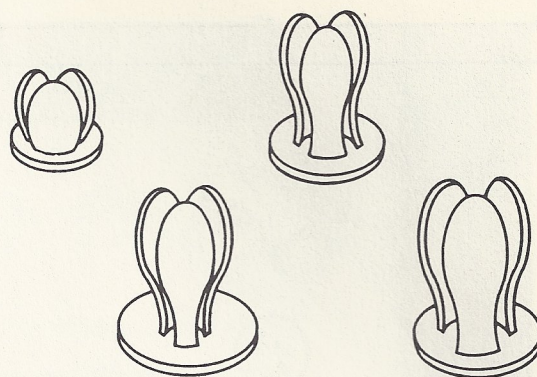


Fig. 9-11



trimounts

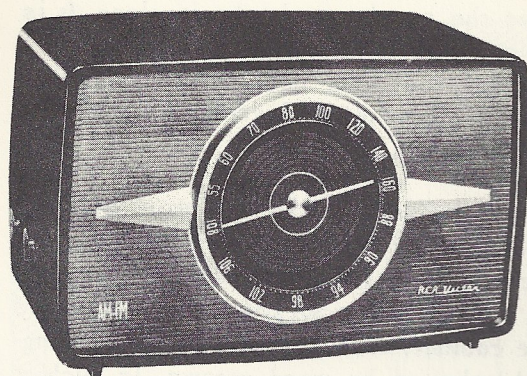
Fig. 9-12

Different types of fasteners are used to hold a back cover in place. Wood screws, machine screws, or push-type spring fasteners called *trimounts* are the most common fasteners. A number of different trimount fasteners are shown in Fig. 9-12. These fasteners hold by spring pressure against the sides of the hole into which they are inserted. They are removed by placing a screwdriver under the head of the fastener and prying it up. To reinsert the trimount fastener, push it straight back into the hole in the cabinet.

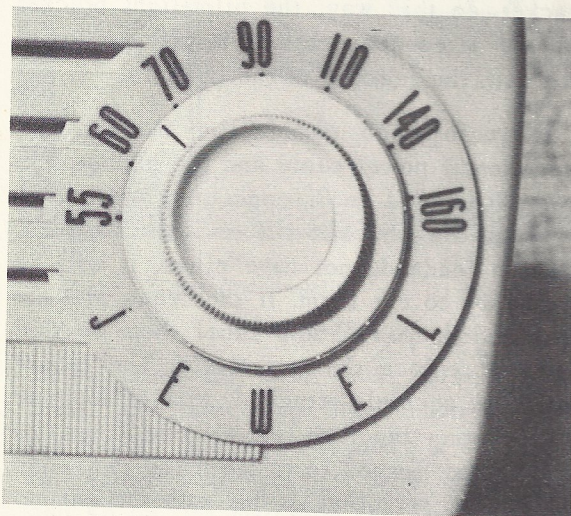
After removing the fasteners that hold the back cover in place, tilt the cover outward carefully to see if a loop antenna or any other wiring is attached to the back. See if the antenna or wiring is held by pin-type connectors or terminals that may be disconnected. If you cannot disconnect the loop antenna, you should decide whether you must unsolder the loop antenna or you can work on the chassis without damage to the loop antenna or other wiring. In most small receivers, you can leave the loop antenna connected if you are careful not to damage it or pull the connections loose while working on the receiver.

Removing the Dial Pointer. Radio dials have a number of different forms. Most dial scales are either round, as shown in Fig. 9-13*a* and *b*, or straight (the "slide-rule" type), as shown in Fig. 9-13*c*.

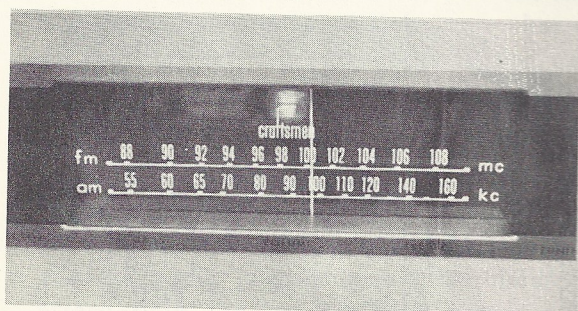
The dial scale shown in Fig. 9-13*a* is attached to the chassis, and both the dial



(a)



(b)



(c)

Fig. 9-13

scale and pointer are behind a glass or plastic window in the cabinet. The pointer need not be removed separately since the entire assembly comes out together with the chassis.

The dial scale shown in Fig. 9-13b is part of the cabinet front, and the dial pointer is outside of the cabinet (like a knob). The pointer is held on the shaft either by spring pressure or by a set screw. This pointer

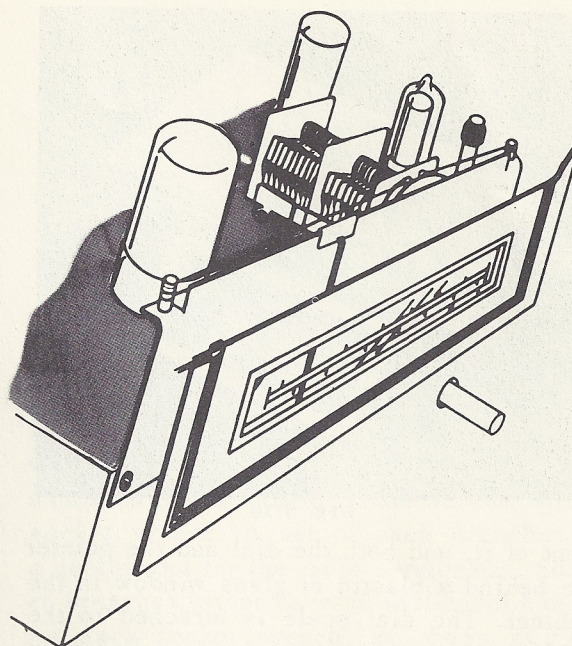


Fig. 9-14

must be removed before the chassis can be removed from the cabinet. It is removed just as a knob is, as described in the paragraphs on the removal of knobs.

The pointer for the straight-type dial scale, shown in Fig. 9-13c, may be attached in a number of ways. Figure 9-14 shows the pointer supported by a back plate so that it is behind the dial scale.

In this case, the entire assembly comes out with the chassis, and the pointer need not be handled separately. Another arrangement is shown in Fig. 9-15; the pointer clips on to the dial scale and appears in

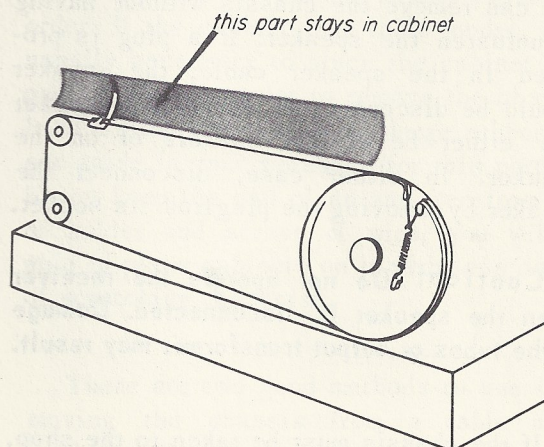


Fig. 9-15

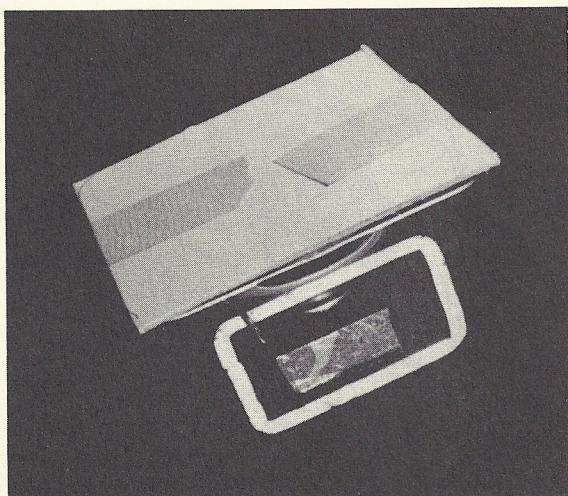


Fig. 9-16

front of it, and both the dial and the pointer are behind a plastic or glass window in the cabinet. The dial scale is attached to the cabinet; the pointer must be detached from the dial scale before the chassis is removed. If it is not, the dial pointer may be bent, the dial scale may be broken, or the dial cord may be pulled off the pulleys. To detach a pointer of this type, lift it up to release it from the dial scale and bring it over and behind the dial scale.

Dial assemblies are discussed more completely in a later Service Practices booklet.

Disconnecting Cabling. In most small sets, the speaker is attached to the chassis, and both are removed as a unit. In larger cabinets and in console models, the speaker usually is attached to the cabinet. The leads to the speaker may be long enough so that you can remove the chassis without having to unfasten the speaker. If a plug is provided in the speaker cable, the speaker should be disconnected. The plug or socket may either be on the chassis or on the speaker. In either case, disconnect the speaker by removing the plug from its socket.

Caution: Do not operate the receiver when the speaker is disconnected. Damage to the tubes or output transformer may result.

If the chassis must be taken to the shop, and you do not have a suitable test speaker,

remove the speaker and take it along. It is good practice to protect the paper cone of the speaker against accidental damage by taping a piece of stiff cardboard over the cone, as shown in Fig. 9-16.

The pilot-light sockets in most sets are attached to the chassis and are removed with the chassis. In some console models, however, the pilot-light sockets may be attached to the cabinet, either by some type of spring-clip bracket or by wood screws. In such a case, unclip or unscrew the pilot light bracket. In this way, the pilot-light bracket and the wires connected to it will not interfere with the removal of the chassis.

In radio-phonograph combination models, the phono-motor power cable and the phono-pick-up cable should be disconnected and pulled clear of the chassis before it is removed. If these leads do not have plugs, it will be necessary to cut them. If the leads are not color-coded, you should label them so that you can replace them correctly. The labels should be securely attached, with cellophane tape or other tape, so that they will not fall off. A good method is to label the two ends of the first wire that is cut with the number 1, the next two wires with the number 2, and

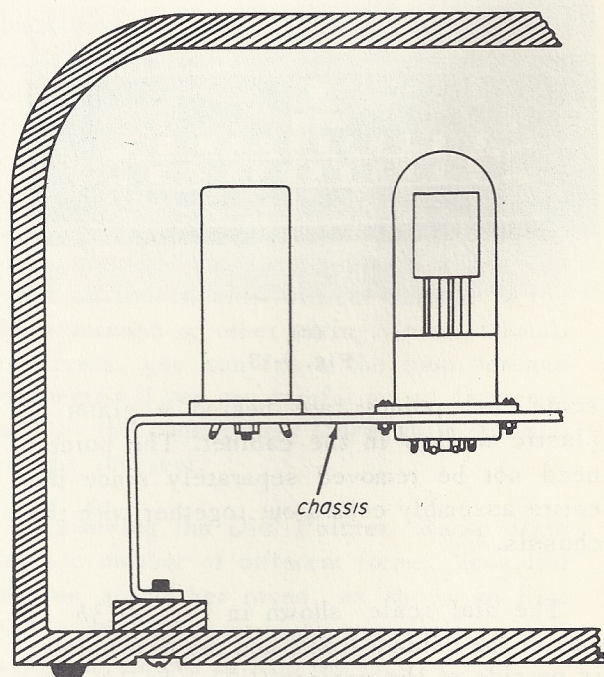


Fig. 9-17

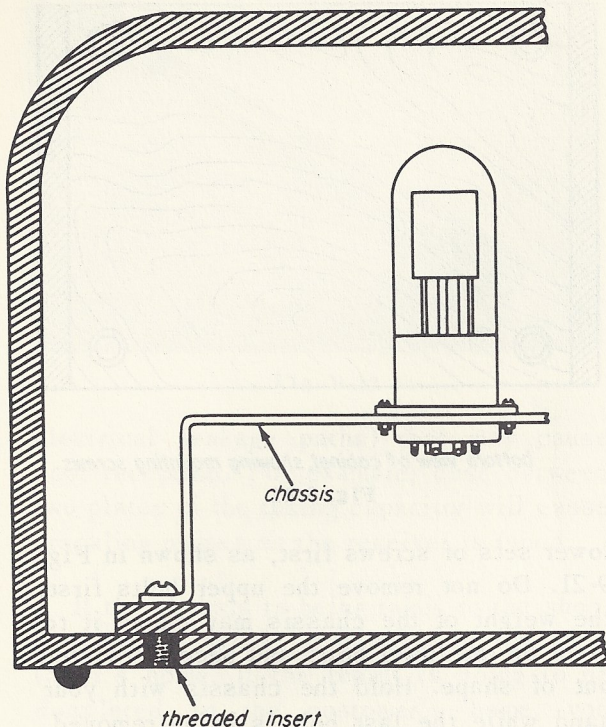


Fig. 9-18

so on. When the receiver is to be reassembled, just match up the numbers. Another convenient method is to make a single knot in each end of the first wire as it is cut, and so on. By matching the knots when the receiver is to be reassembled, you can make the correct connections. Make sure that the connections are securely soldered and carefully taped when you replace the chassis in the cabinet.

Removing the Chassis. After you have removed the knobs, the back cover, the dial pointer, and the cabling, you can remove the chassis itself. In most cases, the chassis is attached to the cabinet with screws. The screws may go through threaded holes in the cabinet into a flange on the bottom of the chassis, as shown in Fig. 9-17, or through a flange on the top of the chassis into a threaded insert in the chassis, as shown in Fig. 9-18. Sometimes the chassis is separated from the cabinet by rubber or some other shock-absorbing material, as shown in Fig. 9-19.

The screws used to hold the chassis and cabinet together may be machine screws, self-tapping (P-K) screws, or hex-head

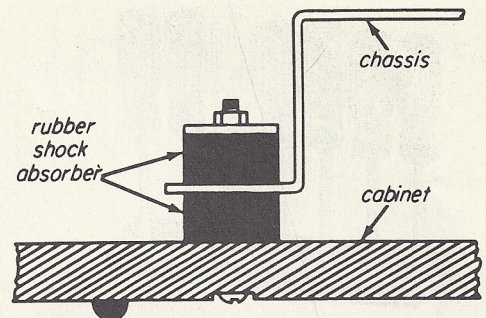
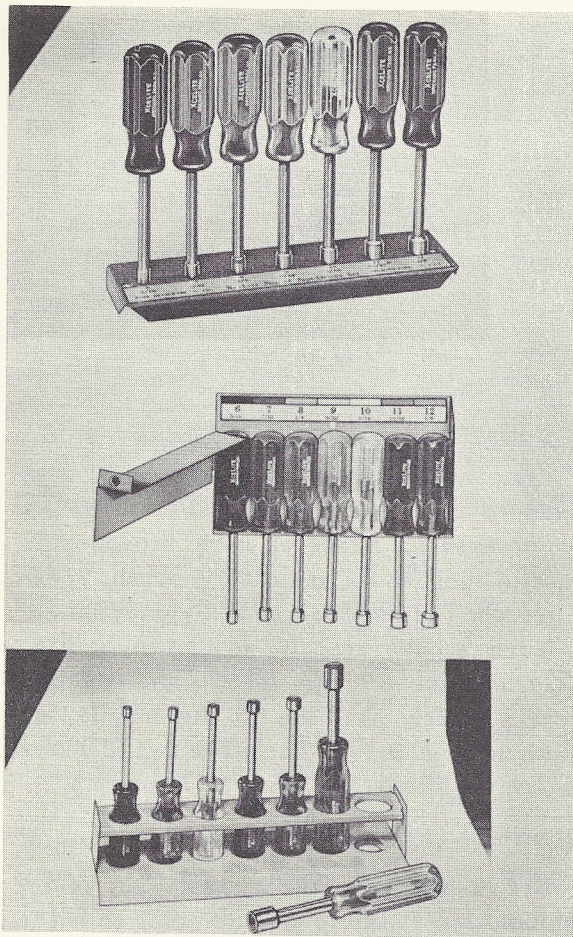


Fig. 9-19

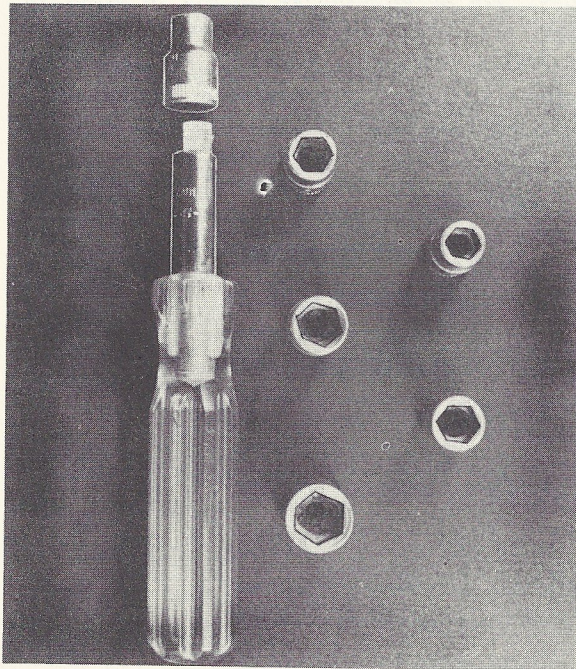
screws. A hex-head screw may have a regular screwdriver slot; if so, it can be removed with an ordinary screwdriver. However, it is easier to remove all hex-head screws with a *socket wrench*. A set of such wrenches is a useful tool for the radio serviceman. Socket wrenches either have an individual handle for each socket wrench, as shown in Fig. 9-20a, or have a single handle and a set of sockets which snap on to the handle, as shown in Fig. 9-20b. The most useful sizes are 1/4, 5/16, 11/32, 3/8, and 7/16 inch.

Before you take the chassis out of the cabinet, decide where you are going to put it. If you wish to use a table in the customer's home, ask permission to do so. In order to avoid scratching the table, cover it with a protective pad. This pad may be made from a piece of heavy cloth or from newspapers. If the cabinet is a console type, the chassis normally rests on a shelf easily reached from the back of the cabinet; the screws that fasten it to the shelf are seldom difficult to get at and may be removed in any convenient order. If the cabinet is a table model, it is usually necessary to place the cabinet on a padded table in order to remove the chassis. It is a good idea to have a large rubber pad set aside in your workshop for this purpose. If you keep the pad clean and free from bits of solder and scraps of wire, you will be able to place cabinets on it with less danger of scratching the finish.

There are two good methods to use in removing the chassis from a table model cabinet. The first method is to lay the cabinet down on its *back* and remove the



(a)



(b)

Fig. 9-20

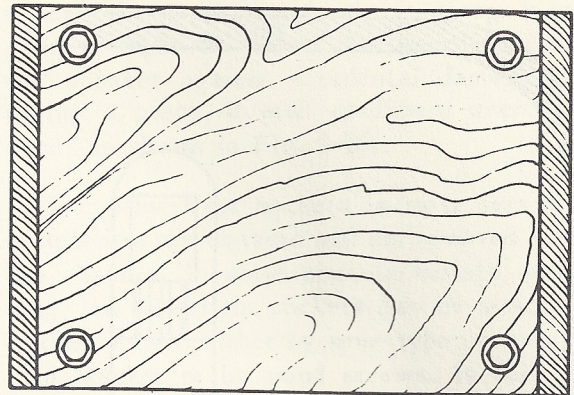
*bottom view of cabinet, showing mounting screws*

Fig. 9-21

lower sets of screws first, as shown in Fig. 9-21. Do not remove the upper bolts first; the weight of the chassis may cause it to pivot on the lower bolts and become twisted out of shape. Hold the chassis with your hand while the last bolt is being removed. Then turn the cabinet upright and slide the chassis out by taking hold of some strong firmly attached part, like a power transformer. Depending upon the cabinet design and speaker location, it may be necessary to tip the chassis or turn it at an angle in order to get it out of the cabinet.

The second method is recommended when the chassis is too heavy to hold with one hand. With the cabinet upright, move it so that the screws at one side are exposed. Remove these screws from below, and then move the cabinet so that the remaining screws are exposed. Remove these screws, replace the cabinet firmly on the table, and slide out the chassis.

9-4. CLEANING THE CHASSIS

Even if the lady of the house is a careful housekeeper, the chassis and the inside of the cabinet will probably be pretty dusty. A thorough cleaning of the chassis and cabinet is one of the things that you should do on every repair job. A clean chassis is more pleasant to work on and will allow you to make a more careful visual inspection. In addition, dust collects moisture (which forms

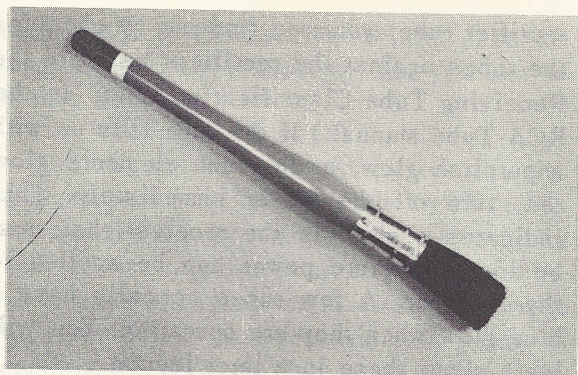


Fig. 9-22

electrical leakage paths) that may cause poor reception. For example, dust between two plates of the tuning capacitor will cause crackling noises as the receiver is tuned.

If the chassis is being taken to the shop, you should avoid cleaning it in the customer's home. If the repair is going to be completed in the customer's home, you should do the cleaning so as to cause as little mess as possible. A small brush or vacuum cleaner may be used for cleaning. A good brush for this purpose is shown in Fig. 9-22. Do your dusting in a well-ventilated area, and avoid inhaling the dust. A small hand vacuum cleaner is good for this purpose, since it does not stir up dust clouds. Carefully remove all dust from the tubes, chassis, and tuning condensers. Clean the dial scale and the inside of the dial window in the cabinet. Any grease or dirt that remains on the chassis can be removed with a brush or rag dipped in carbon tetrachloride. However, do not use carbon tetrachloride on dials or plastic windows; it may dissolve them. A liquid glass cleaner of the spray type is safer.

Caution: The vapors of carbon tetrachloride are poisonous. Use it only in a well-ventilated room, and do not inhale the vapors.

9-5. INSPECTION OF THE CHASSIS

Sometimes, before making any electrical tests, you can find the trouble in a receiver just by looking at it. Since your aim is to find the trouble and fix it as quickly as pos-

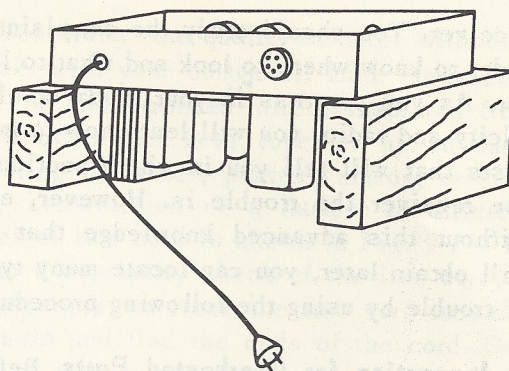


Fig. 9-23

sible, the first step in troubleshooting should be a careful, systematic, visual inspection of the chassis. This you can do without knowing much radio theory.

When you turn the chassis over to inspect its underside, be careful not to lay it down so that the tuning capacitor or other fragile parts will become bent. Have a number of assorted wooden blocks handy so that you can prop the chassis to a good working position with the tuning capacitor or other fragile part of the receiver kept clear of the table, as shown in Fig. 9-23. As the amount of your repair work increases, you may find it is worthwhile to get a commercial chassis holder, one type of which is shown in Fig. 9-24.

Just what should you look for? That depends, of course, on what is wrong with the

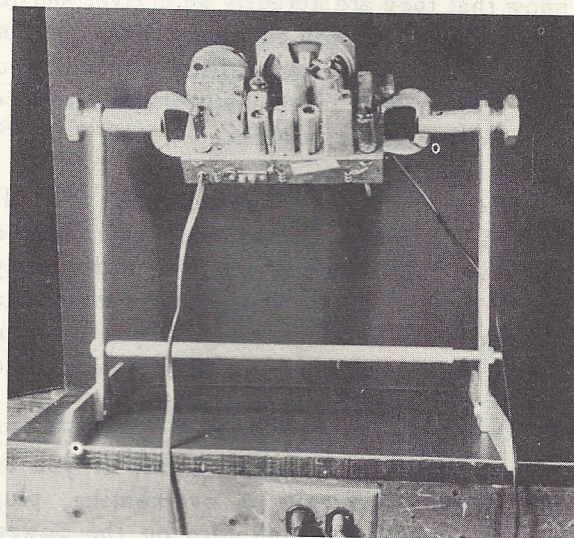


Fig. 9-24

cord that goes to the on-off switch. Touch the other test lead from the ohmmeter, first to one of the pins of the attachment plug and then to the other. The ohmmeter should deflect to zero ohms when the second test lead is touched to one but not both of the two pins of the plug. This indicates that this side of the line cord is *continuous* or unbroken. If the ohmmeter deflects when *both* pins are touched, the leads of the line cord are shorted out, and the line cord must be replaced. If the ohmmeter does not indicate a complete circuit with the test lead at one of the two pins of the plug, the line cord is open and should be replaced.

If one side of the line cord shows continuity, the other side should be tested. To do this, place one of the test prods of the ohmmeter on the end of the line cord that is *not* connected to the on-off switch and place the other test lead end of the meter on the pin of the plug at which no reading was obtained during the first test. A reading of zero ohms indicates that this side of the line cord is also unbroken. If a reading of zero ohms is not obtained, this side of the line cord is open, and the cord should be replaced.

Some line cords on older a.c.-d.c. receivers contain series-resistance wire wound inside the cord, as shown in Fig. 9-27. As the illustration shows, the resistor wire and one of the conducting wires are connected to one side of the attachment plug. The other conducting wire is attached to the remaining side of the plug. In most cases, the single conducting wire is connected to one side of the power switch, and this may be tested for continuity in the same way as you would test a power-cord conductor. The other conducting wire usually is connected to either a tie terminal or one of the pins of the tube socket and may be tested for continuity with your ohmmeter. The resistor wire, which is connected to the same pin, normally goes to one of the filament or heater terminals of one of the tubes. You can tell the resistor wire from an ordinary conductor by the fact that it is usually wrapped in asbestos insulation. So all you have to do

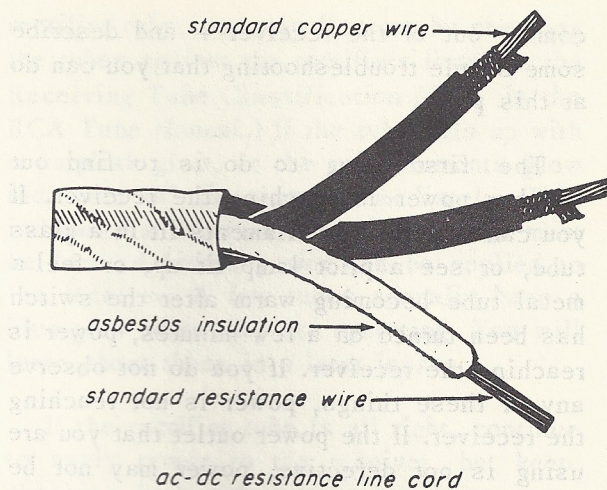


Fig. 9-27

is look for a white conductor that is part of the line cord. You can test this for continuity by placing one prod of your ohmmeter to the attachment-plug pin and the other test prod to the other end of the resistor wire. Because it is a resistor wire, your meter will register some value of resistance instead of going all the way to zero. Therefore, a reading that gives you some value of resistance shows that the resistor wire has continuity. If the meter needle does not deflect at all, it shows that the resistor wire is open and that the line cord must be replaced with another a.c.-d.c. resistor line cord of the same type. In a later Theory Lesson, you will learn how to calculate the value of resistance necessary for the correct operation of the receiver.

2. The on-off switch may be defective. With the attachment plug connected to the power outlet, you can check the switch quickly by shorting it out temporarily with a screwdriver across the two switch terminals, as shown in Fig. 9-28. Be careful to use an insulated screwdriver, and do not let the screwdriver touch the chassis or the outside casing of the switch when the screwdriver is in contact with the switch terminals. If the tubes light when the switch is shorted out with a screwdriver, but not when the switch is turned on, the switch is defective.

Caution: Do not let your hands or any other part of your body touch any of the exposed wiring or any part of the chassis as

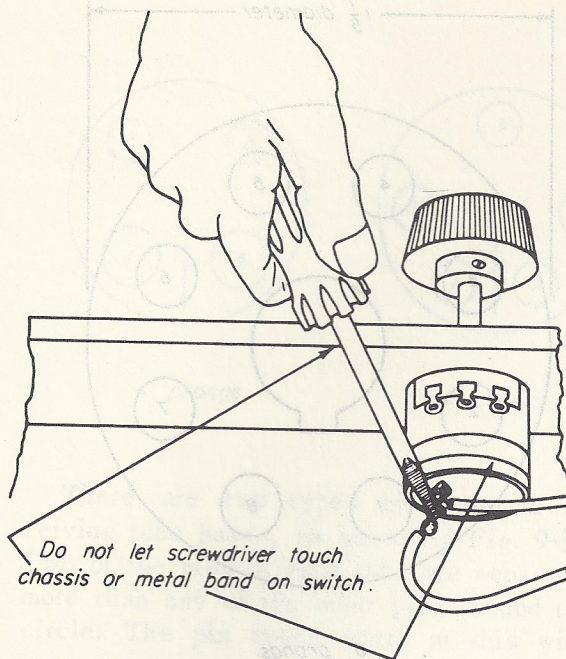
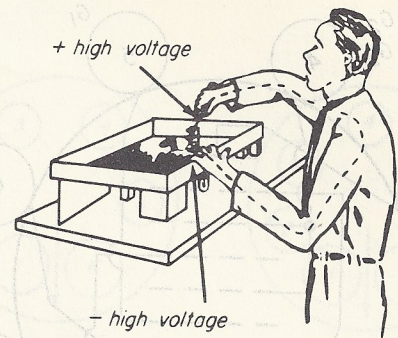


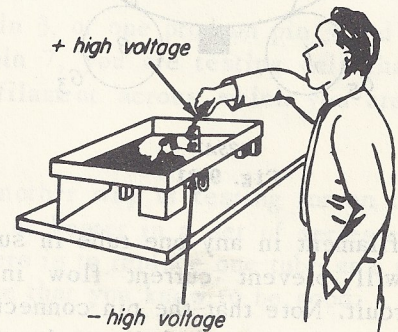
Fig. 9-28

you make tests while the chassis is connected to a source of power. In fact, while making most tests on a live receiver, a careful serviceman keeps one hand in his pocket. He does this to prevent himself from accidentally completing the electrical circuit with his body. Figure 9-29 illustrates this.

3. If the receiver is of the a.c.-d.c. type with series connected filaments, one of the tubes may have an open filament. You can usually identify an a.c.-d.c. receiver by the fact that it does not have a power transformer and has one or more tubes whose filament voltage is 25 volts or higher. (Tubes are usually identified by a combina-



arms and body complete the electrical circuit (a)



body cannot complete circuit (b)

Fig. 9-29

tion of letters and digits. The filament (heater) voltage of such tubes is given by the number before the first letter in the digit-letter combination. For instance, a 25Z6 has a 25-volt filament, a 35Z5 has a 35-volt filament and a 50L6 has a 50-volt filament.)

A simple series-connected heater circuit is shown in Fig. 9-30. As you have learned,

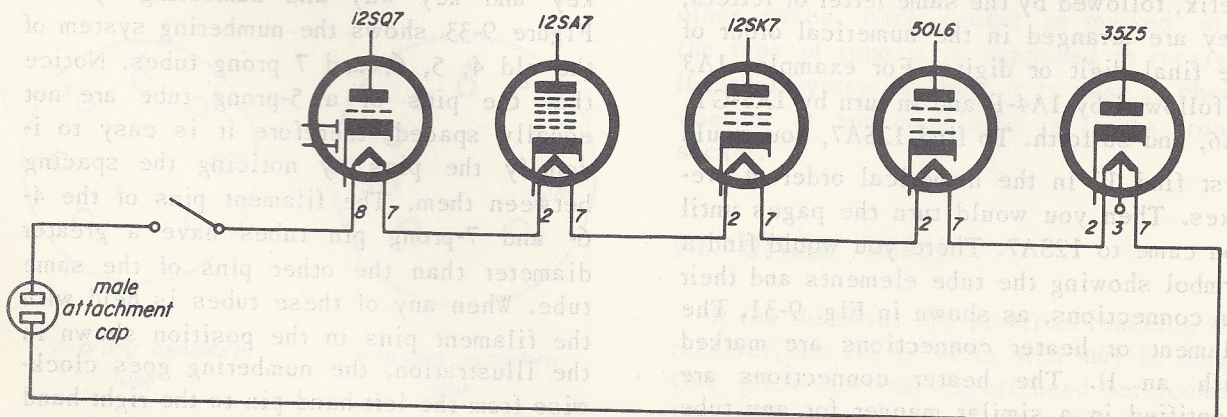
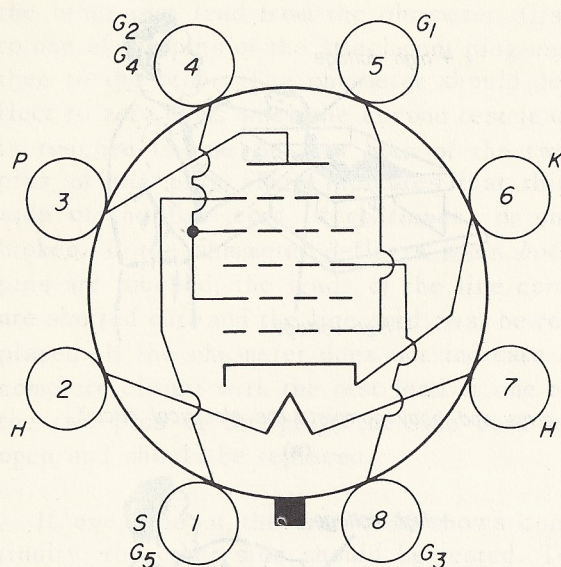


Fig. 9-30

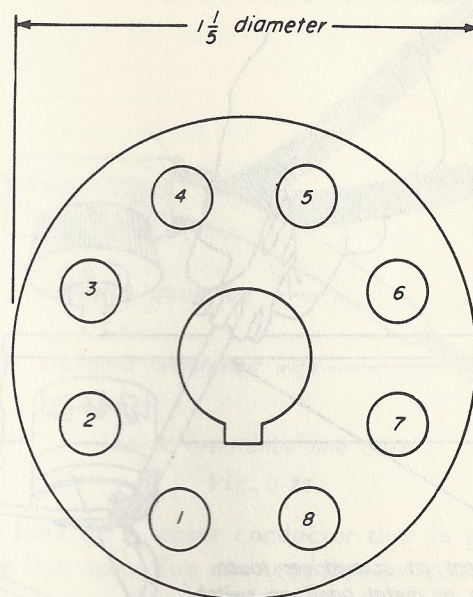


12SA7

Fig. 9-31

an open filament in any one tube in such a circuit will prevent current flow in the entire circuit. Note that the pin connections to the filament are marked for each tube in the circuit. If this information does not appear on the diagram, you can get it by using the RCA Tube Manual. In the RCA Tube Manual, each receiver tube is listed in the order of its numerical prefix, starting with 01-A to 886. Tubes with the same numerical *prefix* (that which appears in the first part of a word or number-and-letter combination) are arranged in the alphabetical order of their letter or letter-combination.

For example 1AC5 comes before 1AD5. Finally, if a tube has the same numerical prefix, followed by the same letter or letters, they are arranged in the numerical order of the final digit or digits. For example, 1A3 is followed by 1A4-P and in turn by 1A5-GT, 1A6, and so forth. To find 12SA7, you would first find 12 in the numerical order of prefixes. Then you would turn the pages until you came to 12SA7. There you would find a symbol showing the tube elements and their pin connections, as shown in Fig. 9-31. The filament or heater connections are marked with an H. The heater connections are identified in a similar manner for any tube that appears in the manual.



8 prongs

Fig. 9-32

The pin connections to all receiver tubes are numbered in a clockwise direction, as you look directly at the pins and with the bottom of the tube facing you, as shown in Fig. 9-32. The 12SA7 has an *octal* base. This means that the base permits the use of up to 8 terminal pins. As the illustration shows, these pins are placed at equal distances around a large central pin. This central pin has a *key*, which is a ridge that runs along the center pin, that fits into a notch, called a *key way*, in the tube socket. The pins of octal tubes are numbered from this key. Starting with number 1 at one side of the key, the pins are numbered in a clockwise order to number 8 on the other side of the key. Lock-in type tubes have a similar key and key way and numbering system. Figure 9-33 shows the numbering system of the old 4, 5, 6, and 7 prong tubes. Notice that the pins of a 5-prong tube are not equally spaced; therefore it is easy to identify the pins by noticing the spacing between them. The filament pins of the 4-6- and 7-prong pin tubes have a greater diameter than the other pins of the same tube. When any of these tubes is held with the filament pins in the position shown in the illustration, the numbering goes clockwise from the left-hand pin to the right-hand pin.

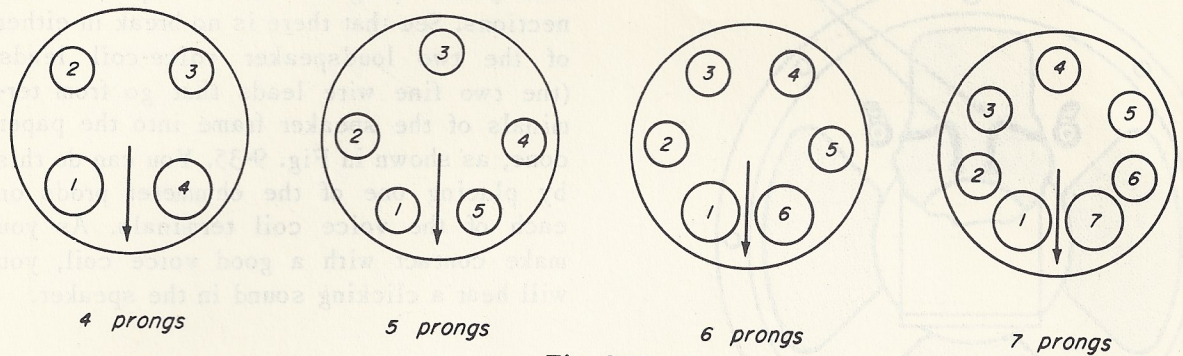


Fig. 9-33

There are two types of miniature receiving tube bases, as shown in Fig. 9-34. Two of the pins of each tube are separated more than any of the other pins around the circle. The pin count starts at this wide space.

You can check whether or not a tube has an open filament by connecting one test prod from the ohmmeter section of your multimeter to one heater pin and the other test prod to the other heater pin. If the heater is continuous, it will be indicated by the deflection of the ohmmeter needle. If the heater is open, there will be no ohmmeter reading. Sometimes filaments or heaters are tapped, as in the case of the 35Z5. In testing such tubes, it may be necessary to test across each section to the filament or heater to discover where the section is open. For example, in the case of the 35Z5, if you place one test prod on pin 2 and the other on pin 7, you are testing the entire filament. If you place one test prod on pin 2 and the other

on pin 3, or one prod on pin 3 and the other on pin 7, you are testing only that part of the filament across which you are connected.

Another way of testing for an open filament or heater in a set of series-connected heaters is to replace one tube at a time with a tube that you know to be good.

Caution: Do not use this method when testing battery portable receivers that also operate from either an a-c or d-c power line. In some such sets, you may burn out each new tube that you use to replace an old tube.

4. Two or more tubes may be placed in the wrong sockets. In many radio receivers and radio-phono combinations, the proper layout of the tubes is shown in a diagram pasted to the back of the chassis, to the inside of the cabinet (in consoles), or to the bottom of the cabinet (in table models). In other cases, each socket is marked with the type of tube it is supposed to receive. If either system is used, it is easy to check whether or not each tube is in its proper socket.

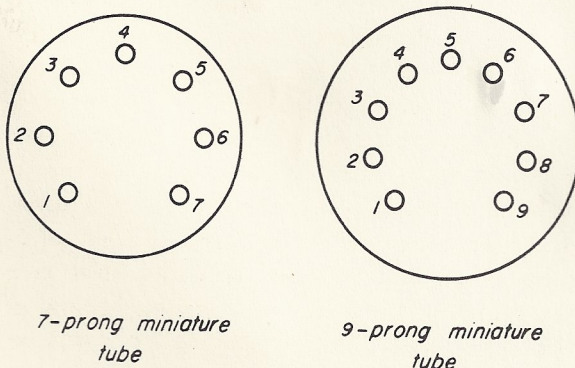


Fig. 9-34

9-6. OTHER TESTS

If the tubes are lit, power is reaching the receiver, but the receiver still may be dead. One quick test that experienced servicemen frequently use is to place a finger on the center tap of the volume control with the

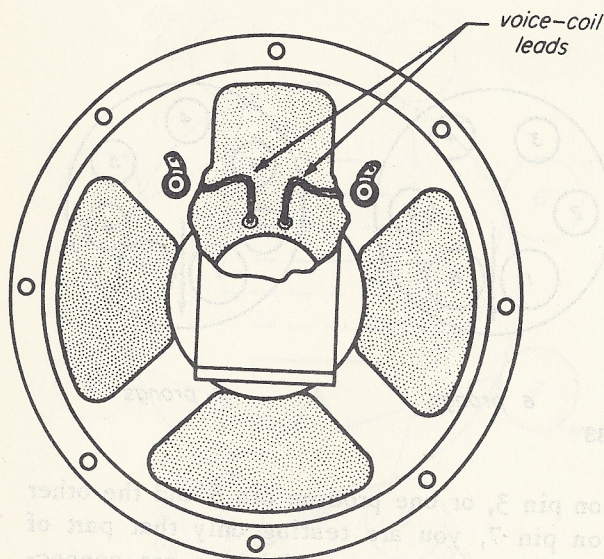


Fig. 9-35

control turned to the maximum volume position. This should produce a fairly loud low-pitched buzzing sound. Later in this course, you will learn how valuable this test is. It shows that the most important trouble is either before the audio section of the receiver (where the audio signals are amplified and reproduced by the loudspeaker). So, if you hear such a buzzing sound, you will know that the audio section of the receiver is probably not at fault but that the trouble is before the audio section. However, if you

do not get this buzzing sound, check the loudspeaker plug and the loudspeaker connections. See that there is no break in either of the two loudspeaker voice-coil leads (the two fine wire leads that go from terminals of the speaker frame into the paper cone, as shown in Fig. 9-35). You can do this by placing one of the ohmmeter prods on each of the voice coil terminals. As you make contact with a good voice coil, you will hear a clicking sound in the speaker.

If the loudspeaker appears to be all right, examine the tuning capacitor plates to see if any of the movable plates are touching any of the stationary plates and causing a short. You can check this by turning the capacitor plates so that the movable plates are completely separated from the stationary plates. This will remove the short if one existed, and a rushing noise will be heard in the loudspeaker. Also examine the connections to the loop antenna or outside antenna to see if they are broken. If these check all right, the next thing to do is to check the tubes, either by replacing them with good tubes or by testing them on a tube checker. In many cases, you will have found the trouble by the time you have completed these simple checks.

